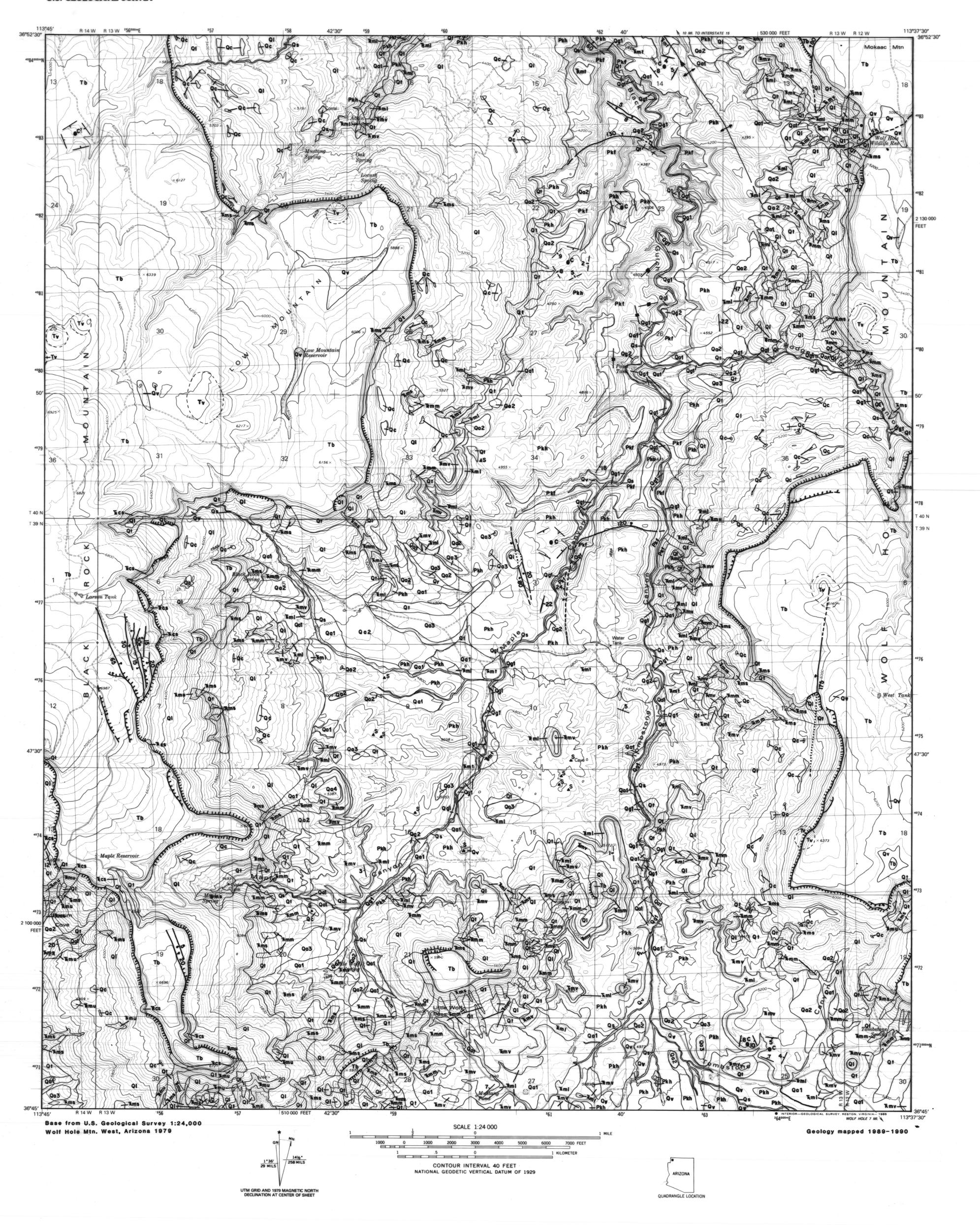
U.S. DEPARTMENT OF THE INTERIOR U.S. GEOLOGICAL SURVEY



CORRELATION OF MAP UNITS SURFICIAL AND VOLCANIC DEPOSITS SEDIMENTARY ROCKS The Wolf Hole Mountain West 7.5-minute quadrangle is in northern Mohave County, Arizona, about 10 miles south of the Utah-Arizona State line (fig. 1). The map encompasses approximately 63 sq mi of northern Arizona. Elevations range from 3,760 ft at Black Rock Gulch to 6,696 ft on Black Rock Mountain. The nearest settlement is St. George, Utah, about 19 miles north of the map area. The main access to the area is by dirt road, locally referred to as the Black Rock road (fig. 2). The Black Rock road leads from Interstate 15 in the northern part of the quadrangle to the southern part.

The area is mostly managed by the U.S. Bureau of Land Management. A section of state land lies in about the middle of the area and some private land is located at Maple Canyon and near the top of Black Rock Mountain (fig. 2). Below 5,000 ft level, the area is sparsely vegetated with sagebrush, greasewood shrubs, cactus, and desert grass; at higher elevations are sparse pinion pine, juniper, and oak trees. At about the 7,000 ft elevation, a small ponderosa pine forest grows on the north slope of Black Rock Mountain. Figure 1. Location map of Wolf Hole Mountain West 7.5-minute quantor northern Mohave County, Arizona. I mi to St. George 113°37'30' VOLCANIC ROCK PERMIAN-TRIASSIC PALEO-VALLEY Figure 2. Map showing selected geographic and geologic features of the Wolf Hole Mountain West 7.5-minute quadrangle, Arizona. PREVIOUS WORK

The area was included in state geologic maps at a scale of 1:500,000
(Wilson and others, 1969), and at a scale of 1:1,000,000 (Reynolds, S.J.,
1988). Geologic maps in preparation of bordering areas include, on the north,
the Purgatory Canyon 7.5-minute quadrangle, Arizona, on the east, the Wolf
Hole Mountain East 7.5-minute quadrangle, Arizona, and on the west, the Mount
Bangs 7.5-minute quadrangle, Arizona.

The quadrangle lies in the northern part of the Shivwits Plateau in the
southwestern Colorado Plateau Geologic Province characterized by Mesozoic and
Paleozoic strata that dip about 3' to the east or northeast. The area is
dissected by tributary drainages of the Virgin River in Utah.

About 1,400 ft of Permian and Triassic rock strata are exposed in the
quadrangle. Triassic rocks once covered the entire area but have been eroded
away except where protected by Late Tertiary basalt flows. The formations
exposed are, in ascending order; the Kaibab Formation (Lower Fermian); the
Moenkopi Formation (Middle? and Lower Triassic); and the Chinle Formation
(Upper Triassic). The oldest rock unit, the Fossil Mountain Member of the
Kaibab Formation, crops out in Black Rock Gulch (northeast part of map). The
youngest Triassic strata, the Shinarump Member of the Chinle Formation, crops
out under Pliocene basalt flows at the south end of Black Rock Mountain
(southwest corner of the map; fig. 2). The highland areas, Black Rock and
Wolf Hole Mountains, are capped by Tertiary basalts. Stream-deposited and
mass-moved surficial deposits cover much of the bedrock area. Details of the
stratigraphy are given in the description of map units.

CEOMORPHOLOGY

Erosion of Mesozoic and Paleozoic strata that dip about 3' easterly to
northesterly has resulted in the development of questas and strike valleys
none of the basalts are regionally tilted but some are locally faulted. One
flow on the east side of Black Rock Mountain is partly preserved on isolated
hills between Black Rock and Wolf Hole Mountains (southwest edge

Circular collapse structures.

Circular collapse structures, minor folds, and other surface irregularities in the Kaibab and lower Moenkopi Formations are due to solution of gypsum and gypsifereous siltstone, especially in or near drainage areas. Some bowl-shaped areas in the Kaibab Formation that have inward-dipping strata may be collapse-formed breccia pipes, originating in the deeply buried Mississippian Redwall Limestone (Wenrich and Huntoon, 1989).

On this map such features, commonly with inward-pointing dip symbols, are marked by a dot and the letter "C" to denote possible deep-seated breccia pipes. They cannot with certainty be distinguished by surface forms from shallow collapse structures caused by removal of gypsum. Moreover, some deep-seated breccia pipes are known to be overlain by collapse features related to solution of gypsum (Wenrich and others, 1986). The deep-seated collapse structures are potential hosts for economic deposits of copper and uranium; the shallow gypsum collapses are unlikely to be mineralized (Wenrich, 1985). Currently, drilling seems to be the best way to determine which collapse structures are breccia pipes at depth.

There are a few shallow sinkholes and karst caves associated with the solution of gypsum in the Harrisburg of the Kaibab and Virgin Limestone of the Moenkopi Formations. These are indicated with the letter "S" and a small triangle symbol. The sinkholes are probably Holocene or early Pleistocene and are filled with colluvial deposits. lenses of silt and sand. Commonly merges with stream channel, alluvial-fan, and talus deposits. Forms a bench about 3-15 ft above modern stream beds. Thickness averages about 3-10 ft Valley-fill deposits (Rolocene and Pleistocene?)--Partly consolidated silt and sand, and lenses of pebble to small boulder gravel; a combination of stream channel, terrace, alluvial-fan, and talus deposits. Subject to sheetwash flooding or temporary ponding; cut by arroyos in larger valleys. Thickly vegetated by sagebrush and grass. Thickness probably as much as 30 ft

Low alluvial-fan deposits (Molocene and Pleistocene?)-Unconsolidated silt, sand; contains gravel composed of subangular to rounded pebbles to boulders of basalt and chert; partly cemented with gypsum and calcite. Basalt clasts are not as common as higher alluvial-fans. Merges with stream channel, talus, and valley-fill deposits. Subject to erosion by sheetwash flooding. Sparse and moderately vegetated by cactus, sagebrush, pinion pine, and juniper trees. Estimated thickness, 10-35 ft

Low terrace-gravel deposits (Holocene and Pleistocene?)--Similar to young terrace deposits (Qgl); partly consolidated. On benches and abandoned stream channels about 10-30 ft above modern stream beds. Merges with and locally overlain by talus, alluvial-fan, and alluvium shed from older surfical deposits. Thickness about 5-20 ft

Low-intermediate alluvial-fan deposits (Holocene and Pleistocene)-Similar to low alluvial-fan deposits (Qal) but contains more basalt clasts; partly cemented by calcite and a gypsiferous caliche, resembling a sandy mixture of plaster. Generally lies at higher elevation then Qal. Moderately vegetated by sagebrush, grass, pinion pine, juniper, and oak trees. Thickness ranges from about 10 to 60 ft

Talus deposits (Golocene and Pleistocene)--Unsorted debris consisting of small to very large, angular blocks, sand and silt; in part cemented by calcite and gypsum. Merges with landslide deposits (Holocene and Pleistocene)--Unconsolidated masses of unsorted rock debri Volcanic center or vent area (Pliocene)--A probable vent area with scattered scattered deposits of light red basaltic cinder and scoria; includes dikes and plugs of dark gray, dense, fine-grained olivine basalt. Sometimes erodes as a circular drainage area. A probable source area for one or more basalt flows of Wolf Hole, Low, and Black Rock Mountains

Basalt flows (Pliocene)--Dark gray olivine basalt; finely crystaline olivine in an aphanitic groundmass. Probably about the same age as basalts at Seegmiller Mountain about 10 miles east of this map dated as 2.35 ± 0.31 and 2.44 ± 0.51 m.y. old (Reynolds and others, 1986). Locally covered by caliche-SEDIMENTARY ROCKS

Chinle Formation (Upper Triassic)

Shinarump Member--A resistant orange-brown to brown, thick-bedded, coarse-grained, pebbly or gritty sandstone and conglomeratic sandstone. Includes flat-bedded, medium trough cross-bedded sandstone sets with interbedded, medium-grained sandstone and conglomerate lenses. Located under basalt flows of Black Rock Mountain, southwest corner of map. Forms prominent cliff. Averages about 100 ft thick

Moenkopi Formation (Middle? and Lower Triassic)--Includes, in descending order, the upper red, Shnabkaib, middle red, Virgin Limestone, lower red and Timpoweap Members as defined by Stewart and others (1972) flows of southern Black Rock and Wolf Hole Mountains. Locally missing at northern extent of Low and Wolf Hole Mountains Shnabkaib Member--Interbedded white laminated aphanitic dolomite and gypsum; red siltstone, mudstone, and sandstone are minor components. Exposed locally below Tertiary basalt flows of Wolf Hole, Low and Black Rock Mountains, and in landslide blocks. Upper contact placed at bottom of unconformity filled by conglomerate of the Shinarump Member of the Chinle Formation. Forms steep slope with some ledges. Thickness ranges from about 375 to 480 ft middle red member--Interbedded red-brown, laminated siltstone and sandstone, white and gray gypsum, minor white platy dolomite, green siltstone, and gray-green gypsiferous mudstone; abundant veins of gypsum in siltstone. Upper contact placed at base of lowest bed of light gray dolomitic limestone. Poorly exposed; forms slope. Thickness ranges from about 150 to 260 ft. placed at top of the highest bed of gray limestone. Thickness ranges from about 50 to 160 ft; average thickness is about 130 ft

lower red member--Interbedded red, thin-bedded sandy siltstone, gray, white, and pale-yellow laminated gypsum, and minor sandstone. Upper contact placed at the base of lowest bed of limestone. Forms slope. Thickness ranges from about 80 to 200 ft; thicknes in paleo-valleys (fig. 2) and pinches out locally against paleo-hills of Kaibab Formation

Timpoweap Member--Includes basal gray, red-brown, conglomerate consisting of subangular to rounded pebbles and cobbles of limestone and chert derived from the Kaibab Formation; pebble supported in some beds with pebbles conforming in shape to one another; where matrix supported, matrix is limestone and coarse-grained sandstone. Above are interbedded yellow and red calcareous, thin-bedded sandstone and siltstone. Fills paleo-valleys eroded into underlying Kaibab Formation in the central and northe-central part of quadrangle (fig. 2). Upper contact is gradational and placed at the first thick bed of red gypsiferous siltsone. Forms cliff. The central paleo-valley is here named Maple valley for exposures in Maple Canyon near the center of the quadrangle. Imbrication of pebbles in the conglomerate in Maple valley redicates an east flow of the depositing stream. The northern paleo-valley is a tributary to Quail valley of the Purgatory quadrangle north of this map. Maple valley averages about 1,600 ft wide and has sloping valley walls; average valley depth is about 300 ft. Thickness ranges from about 0 to 300 ft

Kaibab Formation (Lower Fermian)--Includes, in descending order, the Harrisburg and Fossil Mountain Members as defined by Sorauf and Billingsley (in press)

Pkh Harrisburg Member--Consists of light-gray, sandy, fossiliferous, fine- to medium-grained limestone interbedded with red and gray gypsiferous siltstone and sandstone, and light gray gypsum in beds several feet thick. Beds about 20 ft thick, of cherty limestone and of sandy limestone i inferred; dotted where concealed; bar and ball on downthrown side. Number is estimated displacement in feet
Landslide detachment--Headward scarp of landslide
Anticline--Showing trace of axial plane and direction of plunge; dashed where approximately located; dotted where concealed Strike and dip of strata
Inclined--Strike and dip measured in the field
Approximate--Strike and dip determined photogeologically Implied--Strike and dip determined photogeologically, no measurement

measurement

Strike of vertical joints

Collapse structure--Circular collapses with strata dipping inward toward a central point. May reflect deep-seated breccia pipe collapses originating in the Redwall Limestone

Sinkholes--Cliff or slope walled depressions; collapse features due to gypsum solution. Most are filled with colluvium

GEOLOGIC MAP OF THE WOLF HOLE MOUNTAIN WEST QUADRANGLE, NORTHERN MOHAVE COUNTY, ARIZONA

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